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B-52

USAF's Jet Experience

The Jet Is Just Another New Plane; Transition To It Is No Problem If Thorough Knowledge Of Its Systems, Operational Problems And Procedures Is Developed — An Air Safety Forum Report

By Col. Thomas Savage
Chief Operations Officer, Strategic Air Command

A few preliminary remarks on the types of aircraft that will be discussed appears to be in order to get us on a common basis. The KC-97 tanker is a propeller-driven airplane powered by four reciprocating engines. It is a B-29 family airplane roughly equivalent to the Boeing Stratocruiser transport. The Boeing B-47 Jet Bomber is a swept wing medium bomber powered by six J-47 General Electric axial flow gas turbine engines. We have been operating this aircraft for over four years. The Boeing B-52 Stratofort is the new operational heavy bomber with eight J-57 Pratt & Whitney twin-spool axial flow gas turbine engines. It is understood that this engine also will be installed on the Boeing 707 and Douglas DC-8 commercial transport aircraft.

Crew Member Training

The problems associated with transitioning crew members from aircraft having reciprocating engines to Jet aircraft is indicated by the training program developed for B-29 and B-50 crew member personnel, which was implemented at Wichita, Kansas, during the B-47 Jet Transition Course.

This course did not train combat crews but was pointed toward training of individual crew members. When the first crews were selected, pilots were required to have 2,500 hours total time and 100 hours of 4-engine or 1,000 hours of jet time. Initially, each trainee was given 36 flight hours in a T-33 Jet Trainer. The T-33 is a two-place F-80. This single-engine jet experience gave pilots a feeling for high speed flight and for problems experienced during high speed descent, climb, range orientation problems, etc. It was felt that the B-47 pilot had to develop a line of reasoning compatible with high speed flight so that he could think and fly ahead of his instruments. Because the B-47 has tandem seating and no flight engineer, the T-33 introduced old-time bomber pilots into the operational concept of the B-47 crew configuration and procedures. A few navigation legs were flown in the T-33 but the course consisted primarily of instrument flying. After T-33 transition, the pilot was given B-47 ground and flying training.

Thorough Indoctrination

A thorough indoctrination into B-47 aircraft systems was given during 112 academic hours. In addition, the pilot received three hours of physiological indoctrination, 45 hours of B-47 performance which included a brief study of high speed aerodynamics, 16 hours of jet instrument flight planning and 24 hours of high-altitude weather. The flying training consisted of 25 hours ground instruction and 24 hours of B-47 flight time. Emphasis was placed upon transition, although two-hour navigation legs were flown to give the pilot radio navigation experience in this aircraft. Each mission was usually four hours in duration and included strange field landings.

After about a year's time, several changes were made in the training course. B-47 flight simulators became available and pilots were given complete B-47 missions, including instrument and emergency problems, in this trainer.

With this training innovation, T-33 training was discontinued and four four-hour B-47 missions devoted to instrument work were added to the curriculum. Also, during the first year period, the 112-hour aircraft systems course was reduced to 62 hours. This was possible because of three reasons:

- The maintenance type instructors were replaced with qualified B-47 pilots, who taught only what the pilot needed to know—the nuts and bolts were deleted from the course.
- Instructors had become more proficient in organizing and presenting subject material.
- As more experience and confidence developed, the aircraft was treated more factually.

These latter considerations were applicable also throughout other ground school courses. By these means, the total ground school training was reduced from 200 to 130 hours. Eventually, the requirements for a pilot to enter B-47 training were reduced to 2,000 hours total time, without any stipulation as to 4-engine or jet time;

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or 1,000 hours total time and 150 hours 4-engine time.

Low 'Wash Out'

Experience has proved that these changes in the course did not detract from the proficiency of the pilot at graduation. Less than 2 per cent of the trainees were "washed out." The only significant trend noted in B-47 jet transition failures was that if a man were marginally proficient, it became apparent during instrument work that he was not able to fly ahead of his instruments.

Initially, copilots were given exactly the same training as pilots. Later a change was made which resulted in the same ground training for pilot and copilot, but the copilot received only one-eighth as much B-47 flight training as the pilot.

As regards observer training, each qualified observer was given four weeks instruction in high speed navigation prior to attending the B-47 school. At Wichita, he was given 43 hours of ground school; this included physiological indoctrination, aircraft systems, B-47 performance characteristics, high altitude weather and system training applicable to his equipment. He was given little, if any flight training.

One additional step was taken to refine the technique of personnel entering B-47 operations. When a bomb wing converted to B-47 aircraft, highly experienced B-47 crews were transferred from an older unit and assigned to new B-47 wings as instructors. These so-called professional I.P.'s provided the conversational and standing-operating-procedure type knowledge to the newer B-47 crew members. Their assistance in standardizing techniques and procedures was of great importance to the new crew members.

The training that I have discussed above provided a bomb wing with qualified crew personnel. The final step, which consisted of integrating individual proficiency into a well-trained crew, was accomplished by the bomb wing itself.

Just Another New Plane

General comments upon jet operation and training show that the jet aircraft is just another new aircraft. Flying the airplane requires the same basic physical functions. However, it is a new and slightly more complex aircraft in its systems and in its operation. Crew members must be thoroughly familiar therefore with operation of aircraft systems and must understand operational procedures so well that these become second nature to them much in the same manner that crew members were familiar with aircraft that they had previously flown. This means that some habit patterns must be changed.

The Boeing KC-135 Stratotanker, newest jet transport being built for U. S. Air Force's Strategic Air Command, on its initial flight.

Understanding of new concepts of operation is important because less time is available to analyze an emergency condition and take the necessary corrective action. Also, by the same token, the jet pilot is subjected to slightly greater mental stress than piston pilots because of the faster passing of time during specific flight operations. The speed of physical reaction therefore must be slightly faster. Standardization of cockpit procedures and familiarization with the aircraft cannot be overemphasized. The flight simulator has been of great value to us in increasing the proficiency of pilots. In it, normal flight techniques can be perfected to a high degree and it provides the pilots with instrument work, with multiple emergency problems and, most important, builds up pilot confidence in his ability to fly the new aircraft in a professional manner.

Operational Problems

▶ **Landing:** The biggest problem in transitioning into and flying the B-47, was making good approaches and landings. The poor acceleration and stall characteristics of the J-47 engine were compounded by the low aerodynamic drag of the B-47 airplane, its limited lateral control at low speeds, tandem seating and the bicycle gear. If landing accidents were not directly caused by these factors, they placed the pilots under a psychological handicap, which influenced the generation of an accident. The professional I.P., the installation of the approach chute which we deploy in the air, a reliable brake chute system, change in landing speeds and better engineered and maintained engines have reduced the landing accident rate appreciably.

B-52 Experience

Rather than dwell on the B-47 further, I will turn to our B-52 airplane configuration and experience. We consider that the B-52's flight characteristics during landing are very similar to those of the KC-97, both in regard to engine acceleration and aircraft deceleration characteristics. Almost instantaneous power is available because the J-57 engine idles at approximately 60 per cent and has a double spool compressor, one of which is always running at a higher RPM. Instead of the 15 to 18 second acceleration delay before full thrust becomes available and instead of the critical EGT limits always experienced with the J-47 engines—throttle advancement with the J-57 from idle all the way forward against the stops results in the RPM reaching 100 per cent in six or eight seconds, and the EGT never approaches its maximum limits. Air frame deceleration is provided by spoilers or air brakes which are placed in the "⅓ up" position upon turning onto the base leg. Since the degree to which air brakes are raised can be varied, it is possible to vary the rate of airframe deceleration and to vary the glide path to provide an optimum approach capability. Flare speed over the end of the runway and touch-down with the B-52 is therefore routine in nature.

▶ **Cross Wind Landings:** To go into the cross wind problem, you can expect a greater landing problem with a swept wing aircraft during a cross wind landing. Of course, the problem associated with cross wind landing is the transition from the crabbed attitude to the touch-down attitude. The KC-97 is flown crabbed with one wing low right down to flare.The rudder is kicked in to straighten out the airplane and if

you aren't perfectly aligned, the main wheels of the tricycle gear straighten the airplane out. With nose wheel steering, control is available to further refine the direction of the initial roll. In the B-47, you fly the final approach in the crabbed position with wings level. During flare, you must align the aircraft with the runway by kicking the rudder. As the wing on the cross wind moves forward, its lift increases and the opposite wing drops, due both to its relationship to the air mass and the blocking of airflow by the fuselage. Therefore, during flare, the pilot tries to maintain the dropping wing level. This is a difficult operation in a strong cross wind. Another facet is that after the bicycle gear touches down, the airplane will roll along in line with the path which the pilot established during flare until nose gear steering becomes effective—or in an emergency, the airplane can be aligned with the drag chute. With limited lateral control, you can appreciate that landing a B-47 airplane is a real problem.

The B-52 also has the bicycle type gear and the "roll due to yaw" problem associated with the swept wing configuration. In addition, the B-52 has rudder and elevator surfaces which are about 10 per cent of the total impennage area, as contrasted with 30 per cent control area found in most other aircraft. This condition was necessary to satisfy the high-speed design requirements and to eliminate complicated control surface power boost systems. However, this means limited control during a cross wind landing and a problem in going from the crabbed to the straightened out condition.

Landing Characteristics

To compensate for these B-52 characteristics during a cross wind, we have the capability of offsetting all eight main gear wheels in the direction opposite to the cross wind. The final approach is flown with the nose of the airplane pointed up to 20 degrees off the runway heading, into the wind. The gears are aligned exactly with the runway and the wings are maintained level. The crab is maintained as touchdown is made by keeping the nose pointed off the runway—at all times into the wind. Cross wind landing has required very little training and seems natural after a few practice landings.

To date the B-52 cross wind gear system has been functionally reliable. It has been evaluated under all cross wind conditions and has performed satisfactorily. During heavy gross weight take-offs, it has been used to advantage. The relief from keeping the wings level reduces the physical effort during take-off; also, increased drag, which would result if the control spoilers were deployed, is not a factor—thus permitting the aircraft to take off with minimum ground roll. Let me reiterate, that the cross wind gear installation in the B-52 is dictated by the bicycle gear and the limited rudder control available during cross wind landings.

Experience and design advances have been made in control surface configurations to such an extent that our new tanker, the KC-135, will have control surfaces which provide adequate yaw control characteristics during cross wind landings, and, at the same time, have satisfactory high speed characteristics. This capability, in conjunction with the tricycle gear, eliminates the requirement for a cross wind landing gear system on this aircraft.

▸ **Stopping:** The after-landing problem is obviously important. Good stopping characteristics are important also for the discontinued take-off. Using the landing roll of the B-52 with "wheel brakes only," as a base line, the decrease in roll distance with the brake chute deployed and wheel brakes used is 25 per cent and the roll decrease when full air brakes and wheel brakes are used is 29 per cent. It is interesting to note that air brakes on the B-52 provide greater reduction in ground roll than the drag chute even though the effective drag area of the chute is 3.5 times the drag area of the airbrakes. There are two reasons for this effect: There is a five-second delay assumed from touch-down until the drag chute becomes fully effective, and airbrakes cause a loss of lift in addition to increased drag. The resultant increase in weight on the wheels allows more energy to be absorbed by the wheel brakes, particularly during the early part of the landing roll.

With the B-47 we had no airbrakes and the use of the brake chute was a necessity for high gross weight landings and of some advantage in normal operation in that its use reduced wear on wheel brakes. With airbrakes on the B-52, we carry the drag chute for emergency use only—either in case of air or wheel brake failure or for icy or slippery runways.

The B-47's chute has proven to be a satisfactory expedient for our purpose but we have had a chute actuating problem on that airplane and use of the chute is complicated by the fact that pickup, maintenance, and drying of the chute are required. We are watching jet thrust reversing developments with interest.

Now, I would like to move into the maintenance and material areas. My remarks and data do not include systems and equipment peculiar to combat aircraft, such as air refueling bombing, ECM, etc.

▸ **Malfunction Rate:** I recently compared the malfunction rates of B-47 and KC-97 aircraft. These rates are based upon malfunctions, which occur during a sortie—beginning when the pilot arrives at the aircraft and starts his pre-flight and ending when the engines are cut after the mission. These malfunctions are defined as of the type which preclude further operation of a system and do not include malfunctions which were of such minor nature that the system could be operated satisfactorily or repaired in flight. However, these were not necessarily aborting malfunctions.

Over a five-month period the malfunction rate for the KC-97 was 1.6 times that of the B-47; i.e., for each B-47 malfunction per sorties, 1.6 malfunctions occurred on a KC-97 sortie. The main differences in type of malfunctions between the two aircraft were not difficult to determine. Even with only four engines, the KC-97 had almost five times as many engine and engine installation malfunctions as the B-47 with six engines. On the other hand, the B-47 had more malfunctions than the KC-97 in other aircraft systems.

Generally, it can be said that the troubles in B-47 aircraft systems and components, such as the autopilot, cabin air conditioning system, inverters, and alternators are typical of those usually found during de-bugging and functional testing of newly designed and developed equipment or equipment of the same basic design as time tested units but which have been improved for higher operational requirements. For the failures which are not fair wear and tear or personnel failures, specific deficiencies in system components have been isolated and necessary action has been or is being taken to improve reliability. It should be noted that I have dwelt upon reliability. In regard to operational suitability to provide effective performance, the design and engineering of most installed equipment is adequate and satisfactory. However, this is true now only because we have conducted a number of modification programs to improve the aircraft and its equipment.

▸ **Maintenance Effort:** The accompanying chart shows the direct labor effort required to support B-47 and KC-97 aircraft. In summary, this comparison shows that:

▶ During periods of operation, from the initiation of pre-flight until engine shut-down, B-47 aircraft has been more reliable than KC-97 aircraft.

▶ The effort per flying hour to maintain B-47 aircraft is slightly greater than that necessary for KC-97 aircraft. On a mile flown basis, the utilization of the B-47 is almost twice that of the KC-97.

▶ There are still a few basic deficiencies in both the B-47 aircraft and the J-47 engines; however, fixes have been incorporated which permit the mission to be effectively accomplished with equipment as presently provided.

▶ The state of the art in designing and producing the aircraft's associated equipment has kept pace with aircraft development so that the operational performance of such equipment is generally satisfactory. However, we are still experiencing troubles associated with functional testing and reliability of new equipment.

One other impression might be of interest to you. Generally, we say that once the jet aircraft has started its engines, we feel as though it will complete its mission satisfactorily. With the KC-97 there is some doubt that it will check out, take off and complete its mission satisfactorily. The reliability factor of the jet aircraft therefore permits more firm scheduling, requires fewer available spare aircraft, is good for morale of both operations and maintenance personnel and reduces the number of supervisory personnel required.

Engineering Problems

Now I would like to present some of the specific maintenance and engineering problems which we are facing. It is obvious that I cannot cover all problems which we have recognized and solved.

Accessory equipment and hardware have been developed to such an extent that they are being treated in a debugging manner. However, there are several areas about which general comments might be of interest to you:

▶ **Secondary Structure Failures:** Secondary structure in this case includes fairing, cowling, wing trailing edges, etc. The maintenance effort to support failures of this type of structure is much greater than that associated with reciprocating engine aircraft. This is influenced by two considerations: High speed flight and vibrations from the engine due to both exhaust impingement and to sound. These have been, and continue to be, problems. Because of design and maintenance considerations, we have been afflicted with access doors, wheel well doors, engine cowling and aircraft fairing blowing off in flight. Redesign of these installations, both panels and latching provisions, has been necessary. Flap and gear limit speeds must be observed by operating personnel. Maintenance personnel must repair seals as they become damaged. They must install cowling so that it fits and then latch it properly. Doors must be adjusted as specified. With slower aircraft, we used to have aircraft land with a loose piece of cowling or a hanging access door. With jet aircraft, if installation is not accomplished properly, we return from a mission with a bashed in wing leading edge or ripped fuselage skin—and structural repair of high speed aircraft is more critical, time consuming and expensive. However, we have learned that adequate design, controlled operation and good maintenance will minimize the loss of secondary structure from high speed aircraft during flight.

Vibration Data

In regards to vibration, the engine exhaust introduces vibrations which impose severe loads on the flaps and trailing edge surface of the wings. We want minimum weight in the airframe without excessive fatigue type failures. It appears to me that the state of the art has been such that experience dictates structural beef-up and repair practices. I believe that every new jet aircraft has been afflicted with secondary structure failures until individual problems are isolated by service experience. Popped rivets, small cracks, loose stiffeners will be an additional workload for sheet metal people in the field, although the innovation of honeycomb structure may reduce this effort. This condition is not a safety of flight problem but it requires continuing repairs until local areas are beefed-up.

▶ **Engine Reliability:** Jet engine operation and maintenance was one of the major problems we experienced with B-47 aircraft.

In addition to the poor acceleration and stall characteristics, engine failures and replacement due to foreign object damage was most serious — damage which varied from complete compressor and turbine destruction to small nicks on the compressor blades. With 45 aircraft at a station, we had, at one time, as high as 14 engine failures due to foreign objects in a month. I estimated that 80 per cent of these were due to careless maintenance practices and the J-47 installation configuration. In this aircraft, the engines are fairly close to the ground and accessories which require maintenance are mounted on the nose of the engines.

To date, we have had eight J-57 engine failures in the B-52 due to foreign objects. Two engines have been removed because of foreign object damage. Damage to one of the engines was directly attributable to a poor maintenance practice which has since been eliminated. A second sustained extensive damage to the low compressor as a result of a bird being sucked into the engine. This incident was not observed by members of the flight crew and no unusual engine indications were noted. The damage was subsequently discovered during a post-flight inspection, and emphasizes the reliability of the J-57 engine under abnormal conditions.

The other six engines received some damage to compressor blade leading edges. For this type of damage we must

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JOB TIME STANDARDS

TASK	CLOCK HOURS		MAN HOURS	
	B-47	KC-97	B-47	KC-97
PRE-FLIGHT INSPECTION	3.9	3.4	11.9	6.9
POST-FLIGHT INSPECTION	3.5	3.3	42.0	36.5
ENGINE CHANGE	3.5	13.0	10.5	39.0
ENGINE BUILD-UP			90.5	125.0
ENGINE TEARDOWN			26.0	48.0

MONTHLY AIRCRAFT MAINTENANCE AVERAGES

AVERAGE MAN-HOURS / FLYING HOUR	B-47	KC-97
FLIGHT LINE	16.6	13.7
PERIODIC MAINTENANCE	3.6	3.5
FIELD MAINTENANCE	7.3	8.8
TOTAL	27.5 (38.1)	26.0

AVERAGE MAN-HOURS / N. MILE	B-47	KC-97
	0.065	0.12

AVERAGE MAN-HOURS / PERIODIC INSPECTION	B-47	KC-97
PERIODIC MAINTENANCE	620.6	580.0
FIELD MAINTENANCE	126.0	90.6
TOTAL	746.6	670.6

BOTH B-47 AND KC-97 INSPECTED AT:

PRE-FLIGHT INSPECTION	EACH FLIGHT
POST-FLIGHT INSPECTION	15 HRS.
PERIODIC INSPECTION	200 HRS.

Grand Canyon Was No Accident

The Author Says Pilots 'Must Accept Full And Final Responsibility' Because They've Yielded To The Point Where They Don't Have Adequate Tools To Do Their Job Safely

By Capt. V. A. LeRoy
UAL

Many of my friends not connected with the aviation industry have asked me who was responsible for the horrible Grand Canyon collision. My 19-year-old son, to whom I constantly preach automobile and airplane safety, asked the same question. After trying to explain the situation to him, you can imagine my feeling of frustration when he informed me that he thought I should not maintain that high speeds on the highways, on holiday and week end trips, etc., were hazardous and then continue to fly an airliner under existing conditions.

I would like to deal here with two words, one used in the above paragraph and the other intentionally not used. Grand Canyon was a collision but not an accident. Funk & Wagnalls define "ACCIDENT, *Anything that happens . . . without known or assignable cause.*" If you are in any way connected with the operating end of the air transportation business and are at all sensitive, I would like to suggest that you put this aside and avoid being offended. The collision over Grand Canyon happened with assignable cause and this brings us to the second word, *responsibility* and its closely associated synonym: *duty.*

Again relying on the dictionary "One's duty may be to others or to himself; his obligations and responsibilities are to others. Duty arises from the nature of things: obligation and responsibility may be created by circumstances, as by one's own promise, or by the acceptance of a trust, etc."

Safety Is Prime Concern

Air transportation is not an inherently safe business for the reasons of motion, machinery and the fact that man is not buoyant in air. Therefore, quoting Captain F. E. W. Smith of Trans-Canada Air Lines, because it "is more aptly described as 'made safe', safety is our prime concern." It is the duty and responsibility of all engaged in air transportation to make it as safe as possible. The air crewman has a duty to himself and a responsibility, shared with the air line management, operating personnel and maintenance people, to the traveling public, to the stockholders who own the airplanes, and to his fellow employees to do everything possible to further the safety of this business. This duty and responsibility is also shared with the people of the various governmental agencies which are charged by the Congress to promote aviation and safety in the air. Their responsibility is to the general public, including us. Many people share the responsibility and yet 128 people died in a preventable collision. It is possible that the basic cause of the collision was that too many people share the responsibility and are too quick and eager to shift the blame to the other person, organization or the government.

We, as pilots, are the group that has final and non-transferable responsibility. There is no doubt that we have allowed ourselves to be led into a position, wherein we do not have adequate tools with which we can do our job safely and thus discharge our responsibilities and duties. We recognize that our responsibility is non-transferable; therefore, if the tools are inadequate, it is our responsibility to obtain the proper tools. We would not think of accepting an airplane that was not airworthy. It should be equally unthinkable to accept the present air traffic situation. Perhaps we have not thoroughly evaluated the situation and the limitations of our present concept of collision avoidance. We were certainly warned over Michigan City, Indiana, about thirty months ago. Under our present confused and outmoded concept of collision avoidance, the crewmen involved there, have been called heroes and criminals at the same time.

Responsible Groups

Let us attempt to delineate the responsibility of the various groups that make up the portion of the air transportation industry and the groups of government charged by the public to promote aviation and on whom the responsibility of avoiding collisions falls.

We must accept full and final responsibility. This statement may be hard for you as an individual pilot to accept but as a group we must accept it. We caused the Grand Canyon collision Our crime is that we continue to tolerate an environment that insures a collision with a given amount of exposure. The exposure increases with every new piece of equipment put into use on our airways and with every increase in speed. The pilot group has a better knowledge of this fact than does anybody else in the country. The Air Line Pilots Association has several active committees working on the subject with full cooperation of the industry and government and will solve the problem eventually. In the meantime, 128 people are dead. The interim period between the Michigan City incident thirty months ago and the time the problem will be solved, is the present problem. There is only one obstacle in the way of solving the interim problem. That obstacle is that, up to now, no one has been willing to accept any solution or partial solution that would result in any curtailment of operations. We have within our power, right now, the means of solving the interim problem. It would be necessary to obtain one hundred per cent cooperation from the pilot group to be entirely effective but it can be done. Admittedly, flying all IFR, on airways, with no VFR or 1,000 on top restrictions accepted, is not to be desired but such action on the part of the pilots would hasten the day of adequate traffic control and 128 people would not have perished in a preventable collision.

Unworkable Theory

I would like to digress at this point to explain, for the benefit of the non-pilot reader, that the basic misconcept of our present traffic control system is that the theory of "see and be seen" during clear weather is not workable. All pilots know this, but some of us are prone to ignore it or to depend on the theory that any collision is bound to happen to the other guy. The sky is big and there is a lot of room up there but sooner or later we were bound to have a collision and we will again under the present system with emphasis on the "sooner" because of our accelerated exposure.

The head-on risk was early recognized and a system set up to separate aircraft going in opposite directions by 1,000 feet of altitude. For climb and descent the airways were divided into one way lanes or right-hand side of the road rules. A few years back these rules were adequate because traffic was light and speeds were low and about equal on all equipment. Seldom were departures scheduled so that two aircraft were very near each other going the same direction; and if they were, there were enough altitudes available to assign each a separate altitude and block of air. The only airplanes encountered on a trip were going the other direction on the other side of the "road" and at least one thousand feet higher or lower.

Both air carrier to air carrier collisions to date have occurred when the aircraft were on nearly parallel courses. At Michigan City, the convergence angle, as measured by collision marks on the aircraft, was in the neighborhood of 18 degrees and the air speed differed, according to pilot testimony, by about 15 knots. The computed rate of closure was on the order of 90 feet per second or a little in excess of 60 miles per hour. The bearings and altitude relationship to each other were 66 degrees and down, and 96 degrees and up for several minutes prior to contact. From what is known of the reported positions and altitudes just prior to the Grand Canyon collision, it is possible that similar course, altitude and speed conditions could have existed there.

Dangerous Courses

It has been my opinion for some time that our most vulnerable mid-air collision exposure occurs when aircraft have parallel courses and slight difference in air speed. These conclusions were drawn from the Michigan City collision and from the results of the Civil Aeronautics Administration study on collision course perception and recognition. Altitude changes add to this hazard. The Grand Canyon collision strengthens this theory.

The airline industry is setting new records for business every month and also adding more and faster equipment. Competition is increasing and more and more trips are departing at the same time on parallel, converging or identical routes for the same destinations. The system of airways has become greatly expanded but still there is not enough room, altitudes or blocks of air to accommodate all who wish to be accommodated with a protective clearance at the same time.

As a result operations are curtailed or delayed in bad weather and in good weather the "see and be seen" theory is put into practice. It is not the purpose of this article to explain why the "see and be seen" theory is not workable. Suffice to say, that all who have scientifically studied the problem have found that pilots are not superhumans and as such they perform as all humans do—they are not efficient monitors nor can they see in all directions out of the narrow mouth of a cave moving at over three hundred miles an hour through the air. Airplanes have collided under "see and be seen" conditions and they will continue to do so. Therefore, some method of traffic control or a collision avoidance tool is necessary under all conditions. The railroads discovered that "see and be seen" would not work in their operations and consequently developed a satisfactory control system. I imagine that their operation did not expand as fast as it could have till the control system was developed.

Management's Role

The next group to be considered is the airline management group. A top official of one airline has stated publicly that he could not understand why the second airplane was cleared to fly at the same altitude that the other (or first) aircraft was cleared. He is either misinformed or talking for public consumption. In any event he, as a representative of his group, is sidestepping responsibility for the situation. He should be either better informed or more honest. His attitude does nothing to improve the situation but rather tends to further cloud the atmosphere of an already clouded and confused condition.

Both aircraft were operating "Off Airways" in uncontrolled airspace, outside the jurisdiction of traffic control where it is every man for himself and his own responsibility to avoid collision. There are no assigned altitudes for off airways flying. Our operations manual prohibits flying in the clouds while off airways so it must be assumed that both aircraft were on top of the clouds. One aircraft had a clearance to cross all airways at a definite altitude and the other aircraft was cleared to cross all airways at 1,000 feet (at least) above all clouds. In the direction they were proceeding it was several hundred miles to an airway. Therefore, it must be assumed that they were operating under the "see and be seen" theory and they collided. An attempt to assign a different cause by shifting the blame to someone else and thus attempt to "duck" responsibility tends to delay the day of acceptance by the industry, the Congress and the American public, that the outmoded "see and be seen" theory is not satisfactory.

Of the two possible reasons for the previously mentioned statement by top management, I would like to believe that being misinformed of true conditions is the most likely. There is some reason for his belief. Several years ago, acting in the capacity of Air Safety Chairman for my council, I made an attempt to have the operating management of our airline issue a clarifying explanation of our policy concerning off airways flying. Our Operations Manual states: "Flights may be planned and cleared IFR or VFR . . ., but will be flown off airway under VFR conditions." This is very concise and that is the answer I received to my request. Now it may seem on the surface that my request was rather pointless, however, there was good reason for it. I had heard, and still hear, pilots giving a weather summary on the radio of conditions encountered in an off airway flight which includes a percentage of instrument flying encountered. Now pilots may do things at times not strictly in accordance with the Operations Manual but they do not broadcast it unless, by useage, it has become the accepted thing.

Ducking Responsibility

Operating management is always aware of what is going on and in this case I pointed out to them what they already knew, but I could not get them to issue a bulletin on the subject. In other words I am implying that, in the interest of meeting competition, they encourage IFR off airway flying but continue to "duck" responsibility with a section of the manual that prohibits it.

In addition, Airways Traffic Control personnel (God bless them for it) do attempt to go beyond the confines, the law requires of them, to provide a kind of pseudo traffic protection on the most commonly used off airways routes. The separation provided is not positive, because it is mandatory to maintain the assigned altitudes only when on or crossing airways and does not take into consideration crossing off airways routes as long as the points of crossing airways are separated by 15 miles or so.

Both of these factors have had the effect of encouraging off airways flying on instruments and to a certain extent placing an unofficial approval on the practice. Many pilots believe that the company approves of it and thus it is no wonder that our airline officials might be misinformed also.

There is one bit of evidence that

(Continued on Page 13)

The ALPA Camera

Visits ALPA Home Office

S. A. Colvin, Administrator, acquaints J. Hayeck, President of Syndicate of Employees & Labourers of Transport & Tourist Companies in Lebanon (right), with ALPA operations, during recent visit to Home Office.

NWA Vets

A group of Northwest Orient Airlines' captains who are members of the airline's Twenty Year Club at the organization's annual dinner held in St. Paul recently. L. to r.: W. E. Morgan, L. S. "Deke" DeLong, A. F. Olsen, R. J. McNown, Croil Hunter, NWA's Chairman of the Board; Donald W. Nyrop, NWA president; L. H. Strong and C. L. Wright, Sr. Thirty captains now are members of the Club.

PAI Pilots Evaluate F-27

Piedmont Airlines ALPA Fokker Friendship F-27 Evaluation Committee Chairman D. H. Rieger (sitting, left rear), points out features of new turboprop to T. G. Linnert, head, ALPA Engineering & Air Safety Dept.; PAI V. P. H. K. Saunders, T. H. Davis, PAI President, (standing center), pilot group and company engineering personnel at Winston-Salem meeting to discuss specifications of new transport.

Jet Committee At Boeing

Standing in front of Boeing 707 prototype jet transport at Seattle plant are members of ALPA's Turboprop and Jet Aircraft Committee, l. to r.: R. O'Neill (NWA), J. E. Wood (EAL), T. Latta (AAL), C. Barnes (UAL), J. C. Carroll (TWA), G. M. LeRoux (PAA), Chairman; and Pres. C. N. Sayen. They are listening to J. R. Gannett (second from right) Boeing 707 project test pilot, and R. C. Brumage, Boeing sales engineer. Talks concerned jet operational problems and crew complements.

To Promote Safety In The Skies

Our Air Traffic Control System Has Lagged Behind Aeronautical Progress, Says This Expert. How Can It Be Improved To Avert Future Disasters?

By William B. Harding
Head, Aviation Facilities Study Group
(*From* The New York Times Magazine)

To the casual newspaper reader, the disaster which occurred recently when two airliners apparently collided over Grand Canyon, Arizona, killing 128 persons, was a tragic and frightening thing. To one who has been personally concerned with the growing problem of air traffic control and safety, the accident was not only a tragedy, it was also dramatic evidence of a very real weakness in our aviation facilities—the fact that our air traffic control system and our plans for the utilization of the national air space are not keeping pace with the amazing progress being made in airplane development.

The evidence would have been even more tragic and dramatic if the planes had fallen into the canyons of Manhattan, as might have happened several months ago when two DC-7's were reported to have "brushed" in the air over New York.

Naturally the Grand Canyon disaster has aroused the public. Special committees of both the House and the Senate are investigating the accident—these in addition to an investigation by a House committee which was holding hearings on American aviation problems when the accident occurred.

Clear Picture Needed

Having participated last year in a special study of the same general subject at the request of the Director of the Bureau of the Budget, I am certain that no investigation will uncover any one public or private official who can be blamed for a terrible mistake. It would be unfortunate if the investigations took on the character of a witch hunt, or if political issues should develop from them, delaying still more the concrete action toward a solution that is so desperately needed. On the other hand, the hearings will be valuable if they succeed in giving the public a clear picture of what is required to modernize our national airways, and prepare the way for the heavy capital expenditures which will inevitably be demanded to keep air travel safe and efficient.

Any investigation, I am sure, will discover what we in our seven-month-long study found—that because aeronautical progress is moving ahead faster than generally anticipated, we will have to accelerate our planning and take some emergency action to provide the necessary facilities for handling the ever-growing and faster-moving volume of air traffic. We have to do this just to keep abreast of our current needs, while recognizing that all too soon we must be prepared to meet the even more urgent demands of the Jet Age ahead.

History Traced

One seldom stops to think that a short fifty years ago the vast expanse of sky over the United States was virtually uninhabited by man and his inventions. During World War I and in the period immediately following, aviation was so small in volume that in the Army, it was one of the functions directed by the Signal Corps, while operation of the airways was one of the responsibilities of the Bureau of Lighthouses in the Department of Commerce. Military and civilian users of the air space went their separate ways, and the two almost never met.

Although there was a tremendous expansion and technical growth in all types of aviation in the Nineteen Twenties and Thirties, it wasn't until World War II that the need for coordination between military and civil aviation became acute. In 1946 the President established the Air Coordinating Committee, whose purpose was to examine the problems affecting the many areas into which aviation had spread, and to develop and recommend integrated policies. But by 1953 it became apparent that coordination alone was not enough. Something more was needed. Last year eight civilian consultants of whom I was one were called in by the Government to find out what that was.

Find Vast Lag

Our findings after months of study and interviewing showed clearly that not only is much of our air space dangerously overcrowded, but also that the development of our airports, air communications, navigation aids and especially of our air traffic control system has lagged far behind our needs. Further, our present pattern of air traffic control and lack of facilities are not only impeding flight safety and efficiency, but are also seriously handicapping military training and operations, especially in jet aircraft—this at a time when instant readiness is all important.

Factors Listed

These are the most important factors in the situation:

▶ Estimates of the increase in aircraft movement have consistently been low. In 1948, for example, industry and government predicted airline traffic of between 9 and 11.5 billion passenger miles by 1955. Then in 1951 the Civil Aeronautics Administration revised its figures and predicted that airline passenger miles would reach 20 billion by 1960. Even that revised prediction undershot, for last year the 20 billion mark was reached—five years ahead of expectation. With the increase in commercial and private flying, and the approach of the Jet Age, greatly increased air traffic can be anticipated in the next two decades.

It is estimated that there are about 90,000 active civil and military planes in the United States at the present time, of which about 58,000 are civil aircraft. Although it is believed that the number of active military aircraft will rise slightly through 1965 and then level off as missiles take over some of the functions of manned aircraft, it is anticipated that the increase in the civil aircraft population will be considerable. Altogether, it is expected that there will be a net increase of about 30 per cent in the total number of active aircraft within the next twenty years.

The number of aircraft tells only part of the story. Greater speed and improved performance mean a much greater increase in the number of flights, too.

Collision Risks

▶ The risks of mid-air collisions between aircraft have already reached

dangerous proportions. During the past five years we have had more than sixty-five mid-air collisions involving civil aircraft in the United States, with heavy loss of life. A recent study by a committee of the Air Transport Association indicating that there are, on the average, four near-collisions daily involving the airlines, with 65 per cent of them taking place in daylight, has been given wide circulation as a result of the most recent disaster.

In the future, the hazards of mid-air crashes can be expected to become more dangerous unless preventive steps are taken. With more and faster planes, operating at high altitudes where visibility is poor, pilots can no longer depend on their eyesight to avoid collisions even when the weather is good. The pilot of a modern plane must, of necessity, refer almost constantly to his cockpit instruments, and has little time to spend surveying the sky around him. Even then he cannot see overtaking craft, or planes directly above or below him.

The fast closure of high-speed planes is illustrative of the problem. The pilot of a jet fighter would see an oncoming jet as a speck on his windshield when the approaching plane was about one mile away. By then, however, it is too late to avoid a collision because the oncoming plane will be upon him in four seconds, and time studies have shown that it takes a pilot about seven seconds to change the direction of his plane when he sees an object he must avoid.

Obsolete Air Traffic Control

The present system of air traffic control is obsolete and badly needs modernization. This is true of present air navigation devices to tell a pilot where he is and those that tell him where storm obstacles and other aircraft are located; it is true of devices on the ground to enable controllers to regulate and guide the flow of traffic; it is true of the communication methods between ground and air, the vital link in the control system.

Under the Civil Aeronautics Administration's present system of traffic control, plane positions, which may be in error by many miles because of heavy traffic and the inability to communicate with planes fast enough, are posted by hand in an area's control center. This system, with some refinements and additions, has been in effect since 1935. In 1956, it is neither precise enough nor efficient enough to handle the high-speed and increasing volume of traffic crowding today's airways.

Here then is the answer to the question of why, if the danger of mid-air collisions is becoming critical, we do not have traffic control at all times, in good weather as we do in bad. In bad weather, of course, flights are rationed since the system can handle only a small number of planes in the air. But the tools to control all the planes that operate in good weather simply are not there, and any attempt to force all traffic to fly at all times under control would be impossible. It has been roughly estimated that the capacity of the traffic control system in the New York area is less than half that required to handle all the traffic operating in good weather on an average day.

Lack Of Understanding

The backward state of our control system, with its reliance on manual operation and the human element rather than modern electronics with its automatic and semi-automatic devices, is not, apparently, due to a lack of technical knowledge and an understanding of what is needed. Rather it lies in our whole approach to aviation management and control.

That approach, by civil and military agencies of the Government and private groups, has been piecemeal, with the various groups going their separate ways, then attempting to coordinate their different views through committees. But the process of securing coordination became more and more time consuming, and preoccupation with current problems overshadowed any efforts at long-range planning. More important, when any agreement was reached, the budgetary support and executive decision to put it into effect was frequently lacking.

The result has been conflict, duplication of effort, overlapping of functions and activities and diffusion of responsibility.

States Solutions

What can we do to remedy the problem? Several elements of a solution are already being developed.

Since 1948 two parallel but independent Government projects to provide better air traffic control have been under way. One is the Civil Aeronautics Administration's program on which $110 million has already been expended, with an additional $246 million to be spent in the next five years. The other is the air defense radar network called SAGE (Semi-Automatic Ground Environment) being installed by the military at a total cost of $3 billion. This system, when completed, reportedly will be capable of detecting, identifying and tracking all aircraft over the United States and its approaches.

Although SAGE is designed primarily as an air defense, it is my opinion and that of my colleagues in the advisory group that these two independ-

U. S. Airports Busiest In The World

A traffic count of 11 of Europe's busiest terminal airports, compared with similar traffic at U. S. airports, shows that Chicago's Midway, with 381,737 plane movements in 1955, handled a volume of traffic equal to the combined traffic of London, Paris, Rome, Copenhagen, Oslo and Geneva, with 8,886 plane movements left over, the Aircraft Owners and Pilots Assn., sponsor of the survey announced recently. The AOPA said that the figures indicated that just New York's La Guardia and Chicago's Midway together, handle more traffic than all 11 of the listed European cities combined, with enough left over to equal the present traffic volume at Portland, Me.

Following is the comparative listing for the calendar year 1955, unless otherwise indicated.

European City	Plane movements	Comparable U. S. City	Plane movements
London	119,612	Norfolk, Va.	121,110
Paris	84,072	Chattanooga, Tenn.	84,106
Rome(1)	56,970	Moline, Ill	59,706
Amsterdam	52,676	Hutchinson, Kan.	52,281
Brussels	43,437	Binghamton, N. Y.	43,228
Zurich	62,040	Midland, Tex.	64,619
Hamburg	46,246	Brownsville, Tex.	47,802
Copenhagen	56,216	Roanoke, Va.	58,723
Oslo	28,816	Wilkes-Barre, Pa.	28,408
Stockholm	47,222	Fresno, Calif.	51,210

(1) For 1954; 1955 figure not available

ently conceived and separately developed systems could be not only better coordinated but also developed into one system capable of tracking and controlling safely and efficiently all air traffic without wasteful duplication of men, time, and money.

It should be pointed out that the Civil Aeronautics Administration's system, even when completed, will have about one-tenth the capabilities of SAGE. This is not the fault of C. A. A., which has been limited in what it can do by getting the crumbs from aviation appropriations, and by difficulties in obtaining the specialists and technical information more readily available to the military with its urgent defense problems. At the same time, a common use of SAGE could only be achieved after a period of further development and testing, and making available additional financing, facilities and men. Even so, the opportunity is open to our Government leadership.

Central Planning Needed

Finally, it is readily apparent that a national aviation facilities system, centrally planned and directed and embracing both civil and military use of the air space, is needed. There are too many activities taking place in the sky above us to permit the users to go their separate ways as they once did.

It is also apparent that this planning and direction must be at the highest Government levels. The recent appointment of Edward P. Curtis as Special Assistant to the President for Aviation Facilities Planning is a major step in this direction. There is reason to hope that Mr. Curtis, working with the President's full support and in cooperation with all Government agencies concerned, can find a solution to this national problem.

Whatever the solution may be, it will take time, money, legislation and. above all, continuous central planning and central direction of our national air space, the traffic that moves through it, and the facilities required for its use. Only then will we be able to close the gap between our air facilities and aeronautical development, and provide a control system that is capable of meeting our growing needs.

The question is simply this: Shall the lessons we have learned and the technology we have developed be mobilized to provide a safe, efficient and militarily secure system? Or shall we suffer repeated tragedies as the price of too little done by too many, too late?

The Sport Of Wings

Air Racing And Air Shows Have Helped To Create An Airmindedness That Has Pushed The Aircraft's Technical Evolution As Common Carrier And As Weapon

By Douglas J. Ingells

From PEGASUS

The airplane was born at Kitty Hawk in 1903, but nobody believed it. There was little public enthusiasm for flying or little recognition of the pioneer birdman—except for calling him a "flying fool"—until the early birds got together in Los Angeles and held America's first air meet. That was the beginning of a new era.

For the first time, crowds gathered in grandstands and watched daring airmen like Glenn Curtiss, Roy Knabenshue, Charlie Hamilton and Lincoln Beachey put their winged machines through exciting and thrilling maneuvers around a closed course. The scene was Domiguez Field just outside Los Angeles; the date was January 10-20, 1910. The flyers had a field day, setting new world's records every time they took off. The result was a stemming of aviation interest in Southern California which in later years would bring there a concentration of the great aircraft industry. The same year at Belmont Park race track, Long Island, society's 400, and thousands of others not in the *Bluebook,* witnessed another great international aerial tournament, one which climaxed a series of pre-World War I shows. Ever since, air racing and air shows of one kind or another have helped create an airmindedness that in turn has pushed the technical evolution of the airplane both as a common carrier and as a weapon.

Boost To Research

The "Sport of Wings" stimulated aeronautical research and development in the lean post-Kitty Hawk years, when our military couldn't raise enough money even for the gasoline to run its own tests and experiments. It also gave us during the lull between the world wars the Speed Kings and Air Heroes who kept alive public interest in aviation. Even today, air racing is an effective way to educate the public in our conquest of the skies. National air shows at home and abroad have become the showcase of winged progress, and proof of their import is evident in the fact that it isn't so hard today to "sell" airpower and the need for money to maintain air supremacy. It wasn't always this way.

The guys with guts — the Roscoe Turners, Steve Whitmans, Benny Howards, Jimmy Doolittles — and a long list of those who risked their lives and those who lost them, roaring around the pylons — were really the test pilots who proved many of the innovations that make the modern airplane. It was, as somebody puts it, "a damn big thing when they pushed the speed barrier from 200 to 300 miles per hour."

The racing pilots did that. The guys who flew for the sport of it and the prize money. They made it easier for the test pilots of today to climb into sleek, bullet-like machines and fly faster than sound. You die just as quick when a homemade racer blows up at 275 mph as you do when a $5,000,000 experimental jet explodes over Muroc. And you live a lot longer once somebody else has straightened out the early question marks.

That's what air racing did. It helped us unscramble a lot of unknowns and proved the real worth of a lot of innovations — the high horsepower engines, the supercharger, retractable landing gears, wing flaps, the streamlined engine cowling. In truth, between 1929 and World War II, the National Air Races did for aviation what the 500-mile annual Indianapolis classic has done for the automotive world. Until we had the great multi-million-dollar test facilities for air research and development, the air races were this country's proving ground for wings.

Historical View

Let's look at what happened. At how air racing got that way, its impact on public interest and the changes that have come through the years.

In 1920, Joseph Pulitzer, desiring to stimulate commercial advancement and public interest in aviation, offered a

trophy for closed-course competitions. It was the first posted at the air meet held at Mitchel Field, Long Island, under the direction of the Aero Club of America. With that event, air races were underway.

Through the twenties, the winged contests were usually expensive operations. They ran from three to 10 days, and several cities assumed the host role. Financing was furnished by civic groups in Cleveland, Los Angeles, St. Louis, Chicago, Detroit, Philadelphia and Spokane. During this early period there were various types of racing, including participation by flying teams of the Army Air Force, the Navy and the Marines.

In 1921, the races were in Omaha and in 1922 in Detroit. The 1923 air meet, held in St. Louis, was the first show to carry the name, National Air Races. Its three-day program included a number of special events in addition to the Pulitzer race. The "On-to-St. Louis" derby, open to civilians only, was won by C. S. ("Casey") Jones, who flew the 900 miles from Garden City, Long Island, New York, in 13 hours, 20 minutes.

In 1924, the National Air Races went to Dayton, with a program of events and demonstrations by service planes and civilian flyers designed to honor the home city of the Wright Brothers. The following year they were held in New York, and in 1926 they were invited to be the feature of the celebration in Philadelphia. By this time the races were so well established that cities vied with invitations.

Spokane, Washington, was awarded the 1927 races, which were marked by 12 events, including transcontinental and sectional air derbies. Winner C. W. Holman flew from Roosevelt Field, New York, to Spokane in 19 hours, 42 minutes, 27 seconds.

The 1928 races at Los Angeles in nine days attracted an attendance of over 300,000. New planes for commercial aviation were introduced, as well as Army and Navy "echelon" formation flying.

In 1929, the National Air Races moved to Cleveland with a 10-day show. Here the group of civic and industrial leaders who provided necessary financial and managerial support continued their interest in the shows each year through 1939, when the races were suspended by World War II.

Cleveland, Home Of Races

Cleveland became the home of the National Air Races. Carrying on the tradition of the Schneider and Pulitzer trophies, the Thompson Trophy Race evolved into the national symbol of high-speed flight.

More than a half million people attended the races in 1929. Doug Davis of Atlanta, Georgia, flew his low-wing Travel-Air at an average speed of 194.90 mph to beat both Army and Navy fliers in the free-for-all race. Women flyers were entered on a par with men for the first time. For five and six hours at a time the foremost pilots of the nation, flying the best planes industry could produce, performed for the spectators. Among them were Lindbergh, Doolittle, Al Williams, Freddy Lund, Doug Davis and Army and Navy squadrons.

It was a decade of speed, with racing pilots making headlines and hero stories. Records were broken each year as the pilots raced cross-country, competing for the famous Bendix Transcontinental Trophy. As the homemade jobs took the pylons in the Thompson, the airplane's speed was pushed beyond the 300 mph barrier. There were crashes and deaths. But through it all the races achieved something: they brought out the ingenuity and inventiveness that helped make the airplanes as we know it today.

14th Biennial Convention

The ALPA Convention will be held at the Shoreland Hotel, Chicago, November 5-9.

As General of the Air Force H. H. ("Hap") Arnold said in Cleveland at the 1939 National Air Races, "This is the great test of man and machine. It has been a proving ground in the sky." Shortly after, the races went to war and their builders and pilots with them. Some of the planes became the prototype of our first-line aerial fighters.

Post-War Revival

When the war was over, the races were revived at Cleveland in 1946. But they were not the same. They had lost their individuality. The planes were different. They were not the product of a handful of mechanics and pilots, who fathered them from blueprint into reality. They were the "war babies," the Corsairs, the Mustangs, the Thunderbolts—for the most part the fighter planes of World War II. Not racing planes anymore, but machines — big, powerful, expensive, with no secrets.

With the little racer went the glory and the guesswork and prayer, the win-by-God-or-go-broke spirit that kept the racing pilots of yesteryear in the game. True, they put on a spectacular show as they roared by the grandstand. They broke some records. But it was all pretty cut-and-dried. You measured time and the winner by a slide rule and horsepower, not ingenuity and a checkered flag. "The only thing that these planes prove," a veteran race pilot observed, "is how much guts a pilot has to kick 'em wide open."

The Jets Take Over

The big propeller-driven planes gave way to jets, and the major events, the Thompson and the Bendix, became strictly military affairs. There was no more closed-course racing. Even the name was lost; the races turned into the National Aircraft Show.

Oddly enough, the military, which fostered the childhood of air racing back in 1924, with the event at Dayton, Ohio, was the first to conceive and bring into being the idea of a national air show. It began in 1945, when the Air Force staged its great Air Fair at Wright Field in Dayton. There were fly-bys and some aerial display, but the heart of the event was exhibition — planes and equipment on parade, static display on the ground.

Since that time, on an annual basis, the National Aircraft Show has been held in Cleveland, Detroit, Dayton and Philadelphia. This year Oklahoma City plays host. Sponsored by the aircraft industry and the military services, the show is still held under the auspices of the Cleveland National Air Races, the same group who brought the air races into national prominence back in 1929.

Today the air show is an event designed to demonstrate to the public the technical advances made by aviation. It is the "Big Show" that parallels the national displays of Russia and England. Aviation progress still soars upward, but the "Sport of Wings" is almost dead.

Grand Canyon . . .

(Continued from Page 7)

might possibly indicate that airline management is more aware of the hazard of mid-air collisions than they wish to acknowledge. The word *possibly* is used, because the evidence is not conclusive. In the *Wall Street Journal* of Friday, July 13, 1956, was a news item stating that both airplanes were insured for substantial amounts. One policy was reported to be with Associated Aviation Underwriters and the other with Lloyds. I have been told that all risk coverage for airline aircraft comes

pretty high. Could it be that the carriers think enough of the increasing collision risk to realize that premium rates for this coverage only, based on past history of collisions, would be a bargain? I doubt if any amount of sleuthing could produce an answer, but I do think we are entitled to an answer to the question, "Was the risk coverage for these aircraft limited or all risk?"

States Position

I am attempting in this article to be honest and soul searching in my evaluation of the situation. My sole purpose is to promote safety in the air. I state things as I see them and the chips will fall where they may. If I seem to single out one company or group of pilots, it is only because I am more acquainted with them. We are all in this business together and all are guilty. Unless we face this fact we cannot solve the immediate problem. I have a lot of faith in Sam Saint's predictions for traffic control in 1975 and in Carl Christiansen's committee work on a collision warning device. Airplanes are flying now and we have a problem that must be solved now. I have no illusions of immediate accomplishment of what I ask of my brother pilots, air line management, the Civil Aeronautics Administration, the Congress, or the people. I have been rebuffed before but, like the spider, I shall always try again. My original attempts were prompted by a collision in which we were very fortunate because no lives were lost. I felt that never again could we be so lucky. I had no way of predicting numbers of lives or who they would be, but I did know for a certainty, that it would happen as I know it will again, if we do not change our ways. 128 this time, next time maybe more, maybe less, maybe me, maybe you, but for sure some of us.

The Civil Aeronautics Act of 1938 as amended, charges the Administrator of Civil Aeronautics with the responsibility to make provision for the control and protection of air traffic moving in air commerce. The system now in use is out-dated and generally known to be unsatisfactory by all in the industry. In order to handle the volume of traffic the system must transfer the responsibility of collision avoidance to the cockpit under the "see and be seen" theory. The Civil Aeronautics Administration Technical Development and Evaluation Center in Indianapolis has flown two DC-3 airplanes at each other more than one hundred and forty times to measure pilot reaction under simulated daytime collision conditions in ideal weather only. I have not seen the report of this evaluation, but I have been told that the results fail to support the theory of "see and be seen" as a satisfactory means of avoiding collisions in aircraft as low as the DC-3 under ideal conditions. If this is true, then it follows that the Administrator has knowledge that the theory is not workable and will not prevent mid-air collisions. By continuing to use the theory, by allowing VFR flights and issuing VFR restrictions in clearances, the Administrator is not discharging his responsibilities to the public as charged by the Congress.

Congress' Failures

The Congress too has failed its responsibilities to the public by failing to appropriate the amount of money required to install the needed system of traffic control. The public has also failed in its duty to itself by not demanding it.

In spite of all this the final responsibility falls on the pilot and he cannot "duck" it. Too many of us insist on VFR restrictions being self-applied by filing and flying with no clearance under conditions that demand traffic protection. The responsibility is ours and we are in the best position to do something about it now. I realize, as do most air line pilots, that one hundred per cent IFR control will never work under the present traffic control system. I also believe that eventually it will break down, due to increasing load, regardless of the ground system developed. We need an electronic warning device to supplement the partial traffic control system to be developed. This will all come and I want to be here to use it. I am asking that the air line pilots take this matter into their own hands and do something about it. It is evident that the carriers and the government have been ducking the responsibility that we cannot duck.

We cannot achieve entire freedom of collision risk but at least we can achieve freedom of risk of collision with each other during the largest portion of our

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operations. Our greatest problem would be the military and itinerant aircraft operation at our altitudes.

Needs Outlined

I am asking that all air line pilots:

- File IFR for all flights above 5,000 feet above the terrain.
- Accept no VFR or on top restrictions for above 5,000 feet above the terrain or while operating at speeds in excess of 160 kts at any altitude.
- Refrain from off airways flying, except for the purpose of avoiding thunderstorms by deviating from airways, until such time as ARTC can provide traffic separation from other air carrier aircraft on such routes.

Admittedly this is a stop gap measure and leaves a lot to be desired. Operations would be somewhat curtailed. Possibly some of us might lose our runs. Management would probably not like it but again they might if all of us operated under the same conditions. One thing is sure: If we had put this or similar measures into effect after the Michigan City collision, 128 people would not have needlessly plunged into the Grand Canyon and in all probability the needed traffic control system and the more sorely needed collision warning device programs would be further advanced.

In my estimation this is the only way we can properly discharge the responsibility placed on us by the people who ride behind us and the duty we have to ourselves to be safe in the air. Let us act like air line captains and face our duty squarely.

Jet Experience . . .

(Continued from Page 5)

change compressor rotors but commercial engines will have moment-balanced blades which can be installed without rebalancing the rotor. The low rate of foreign object damage is due to the increased experience level of our maintenance personnel and the cleaner aircraft installation; the engines are higher from the ground, and the J-57 is better able to reject or digest foreign objects without damage. It is too early to know if this trend will continue when less experienced personnel are assigned to crew our B-52 aircraft.

From a flying safety and a maintenance standpoint, rigorous inspection of the first two stages of compressor blades for nicks or dents is necessary. However, we are not positive that the first stage will indicate that an object has passed through the compressor and that damage has occurred to the rear of the first rotor or to the second rotor. If damage does become extreme in flight, it has been noted during B-47 operations by seeking either compressor blades spewing forward of the engine or by high EGT and low RPM. On the B-52, it would be indicated on the engine pressure ratio gauges as well as by the EGT and fuel flow. We have had no J-57 engine failures accompanied by incidents which occurred with some J-47 engine failures; that is, the engine being sheared from the engine mounts or turbine blades erupting through the turbine case.

EPR Systems: The engine pressure ratio system which is new with B-52 aircraft indicates the amount of thrust developed in an engine by comparing the ratio of pressures at engine inlet and exhaust.

This instrument has a function similar to the torque meter installed in airplanes having reciprocating engines. The EPR indication is necessary to establish throttle position for correct power settings during climb and cruise and to determine if required thrust is available for take-off. Also, it provides a positive indication of whether the pilot is obtaining augmented thrust from water injection. This instrument has relegated the RPM gauge to a secondary instrument and the EGT to a primary check instrument. It is most important that the engine pressure ratio indicating system be reliable and used properly. This is a new system and we have reliability and de-bugging problems with the equipment at the present time.

Summary

In conclusion, it has been shown that on a miles flown basis that the B-47 aircraft has had a lower malfunction rate, requires less maintenance effort and is considered to be a more reliable aircraft on a schedule basis, than piston-engined aircraft. There have been problems in the development of the aircraft and its associated equipment. The transition of personnel to jet aircraft is not a problem if a thorough knowledge of the aircraft systems and a second nature understanding of the operational problem and procedures is developed by crew personnel. Progress has been and is being made to simplify the maintenance and operation of aircraft, as evidenced by our B-52 experience. Increased development to improve reliability of equipment and to simplify operational problems is necessary. This is possible through education and efforts of people who must support all phases of aircraft development and operation.

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